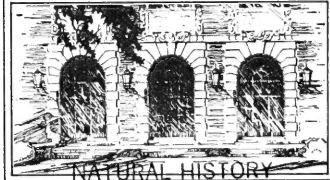




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NATURAL HISTORY
SURVEY



The Literature of Arthropods Associated with Alfalfa

1. A BIBLIOGRAPHY OF THE SPOTTED ALFALFA APHID

Therioaphis maculata (Buckton)
(Homoptera: Aphidae)

D. W. DAVIS, Utah State University

M. P. NICHOLS · E. J. ARMBRUST

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Subproject Director: E. J. Armbrust

Principal Investigators:

Illinois: E. J. ARMBRUST and W. G. RUESINK

Utah: D. W. DAVIS

Nebraska: D. G. HANWAY and E. A. DICKASON

New York: R. G. HELGESEN

Kentucky: B. C. PASS

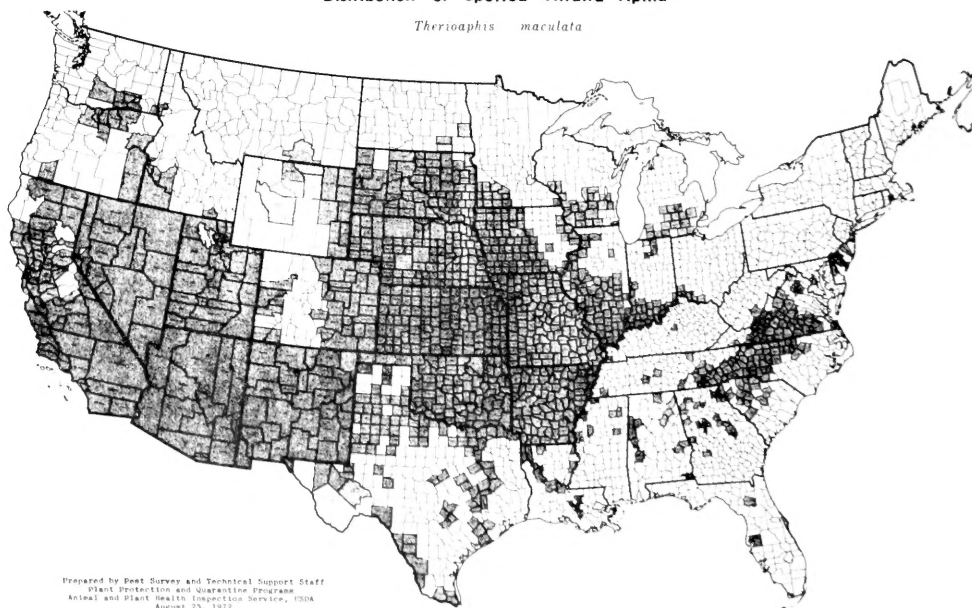
Virginia: R. L. PIENKOWSKI

California: V. M. STERN

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Distribution of Spotted Alfalfa Aphid

Therioaphis maculata



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The Literature of Arthropods Associated with Alfalfa

I. A BIBLIOGRAPHY OF THE SPOTTED ALFALFA APHID

Therioaphis maculata (Buckton) (Homoptera: Aphidae)

THE ALFALFA ECOSYSTEM is unique among field-crop systems in that it represents a relatively long-lasting, well-established, perennial system that exists nationally over a variety of climatic, geographical, and edaphic conditions. Because of these many subsystems, the interactions with other specific agroecosystems or natural systems are equally as varied. Alfalfa supports a wide variety of insects. These include destructive insects, pollinating insects, species that inhabit the fields because of the lush habitat but have little effect on the crop, and many other associated predators and parasites. Because of the perennial growth habits of alfalfa, many pest and beneficial insect species of other crops overwinter or build up in alfalfa before migrating to neighboring crops systems.

Considerable laboratory and field data dealing with chemical, biological, and cultural methods of controlling alfalfa insects are available. These data need to be closely interpreted with respect to their implications for integrated control and then applied in integrated pest management programs in the field. The breadth and depth of research on alfalfa insect control and alfalfa production in general have been sufficiently productive to implement some programs now.

To facilitate better use of existing literature in developing pest management systems, bibliographies of the key pest species on alfalfa are being prepared in cooperation with the Soybean Insect Research and Information Center (SIRIC) at the Illinois Natural History Survey and University of Illinois. SIRIC has developed a set of computer programs for the IBM/360 at the University of Illinois, which makes possible the retrieval of literature citations associated with a subject or combination of subjects. The bibliographies of the key alfalfa pests, starting with *Therioaphis maculata* have been stored on magnetic tape and are retrievable using the SIRIC system.

Damage from the spotted alfalfa aphid was first recognized in the United States during 1954. When it was first reported, most of the workers believed that it was a form of the yellow clover aphid which had become adapted to alfalfa. Within a couple of years it was found that this was not the case. The spotted alfalfa aphid was apparently a new introduction into the United States from the Near East. The first reports were from New

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Mexico, but it required only a couple of years for the aphid to spread throughout the southwestern part of the United States. Shortly thereafter it was widely distributed through most of the country. It is still considered essentially a warm-climate insect best adapted to the southern tier of states. It has the ability, however, to spread rapidly on wind currents, so by mid- or late season, it often spreads well into the colder areas of the Rocky Mountains and Midwest.

The spotted alfalfa aphid is much smaller than the pea aphid and can be readily distinguished both by size and color. It is yellowish with dark spots. It also produces much more honeydew and can usually be recognized by the sticky mess. When disturbed, these aphids actively jump from the plants. Summer winged forms are produced in much larger numbers than the pea aphid.

Damage to the alfalfa plant is of several types. The possibility of virus transmission has been discussed by several authors, but has never been verified. Many workers believe that the aphid is capable of producing a toxin which is injected into the alfalfa plants, helping to produce symptoms. Young plants of susceptible varieties can tolerate very few aphids without being killed. The tremendous amounts of honeydew produced have created problems such as clogging of harvesting equipment. Mold growing on this honeydew reduces livestock acceptance of the alfalfa. Stunted plants, poor seed set, and short stand life are typical symptoms.

The spotted alfalfa aphid is a one-host-plant aphid. It has a continuous life cycle on alfalfa and normally does not produce sexual forms in the fall. This means that the best survival of the aphid occurs in areas where there is alfalfa growth during the entire year. The adult aphids often crawl down around the base of the plant where they are capable of surviving during the winter unless the climate is too severe. In cold areas, there may be complete mortality. This is the basic reason that the spotted alfalfa aphid is a problem primarily in warmer climates. Starting about 3 years after its initial introduction into the United States, a few sexual forms were noted during the fall of the year. These sexual forms have never become numerous, but they are a prelude to egg laying on alfalfa stems. There is evidence that the spotted aphid populations in the northern areas, such as South Dakota and Minnesota, have been gradually selecting for larger numbers of these sexual forms. Even with these fall egg-laying aphids, *Medicago* spp.

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remain as the only hosts on which the insect can complete its full cycle. Occasional collections have been made from other legumes. The aphids multiply extremely rapidly during the summer, producing a large number of winged forms. These winged forms are carried by wind currents very readily and have been picked up at high elevations by aircraft. This summer distribution of winged forms can take place over several hundred miles.

Control measures have taken three major pathways. The first and probably most important of these has been the development of resistant alfalfa varieties. The resistant varieties are tolerant to the toxin of as well as the feeding damage by the aphids. Several very successful parasites have been introduced into the United States and unquestionably these have been instrumental in reducing the spotted alfalfa aphid damage in southwestern areas. In addition to the introduction of parasites, quite a number of the native predators also aid in biological control. The third major approach has been with insecticides. Initially, most of the work involved materials like parathion, but more recent chemical control has centered on the systemic insecticides.

An important aspect of the spotted alfalfa aphid biology is the rapidity in which it develops new biotypes or localized forms. These biotypes have developed in response both to insecticides and to overcoming the resistance of alfalfa varieties. In some of the areas, for example in Arizona, the location of these biotypes has been mapped, but in areas further north, which are reinfested by flights from the south, there has been considerable confusion. The aphids, which are blown northward to establish annual populations, do not always originate from the same source; thus the type of insecticidal resistance varies considerably from year to year.

Sources for the entries listed in this bibliography were *Index to the Literature of American Economic Entomology*, *Review of Applied Entomology, Series A*, *Science Citation Index*, *Zoological Record*, *Agricultural Index*, and references cited in the articles. All entries were examined by workers, either at Utah State University or the University of Illinois, except those preceded by the symbol #. The references are listed alphabetically by author(s) and numbered consecutively. A subject table containing the reference numbers appears on page 13. References are arranged according to subject and period of publication. The table is intended as a quick subject index to the references in the bibliography. More in-depth indexing was done for the SIRIC system, and is available to researchers.

References to *Therioaphis maculata* found in the USDA Cooperative Economic Insect Report, 1954-1972 are included as an appendix following the numbered references. Abbreviations and complete titles of the sources which appear in the bibliographic entries are to be found in a listing at the end of the paper.

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ECOLOGY		67,151,163,181,234	139,150,264	140,199,200,244,267	120,197
DISTRIBUTION	30	1,8,28,35,38,41,115,119, 121,149,162,164,172,188, 208,217,246,249,250,258	150	25,93,114,118,137,201, 270	
HOST PLANTS		14,15,38,177,251	18	253	
TRAPPING & SAMPLING		28,35,44,50,147,246,262	43	137	
ECONOMIC ROLE & DAMAGE	247	8,14,15,20,29,38,40,80, 115,116,117,119,121,122, 148,165,166,171,173, 174,178,179,193,208, 215,220,245,249,251,252, 265,269	11,18,32,74,83,144	33,77,87,99,253,254	7,103,143,195
DISEASE TRANSMISSION		146	98	266,271	5
PARASITES & PREDATORS		12,14,15,24,28,38,56,58, 59,62,66,67,119,145,154, 165,204,211,214,218, 219,246,250,257,258, 260,261,262	10,18,51,52,53,98,139, 142,152,159,203,205, 206,207,212,226,229, 240,263,264	54,55,118,131,133,140, 141,160,182,185,186, 227,239,254,267	7,221,241
NONINSECTICIDAL CONTROL METHODS		28,62,68,69,70,71,72,73, 246	18,98,203	254	
INSECTICIDAL CONTROL METHODS INCLUDING TOXICOLOGY	30,247	2,12,14,15,16,17,19,20, 27,39,45,46,47,48,67,78, 165,166,167,178,183,184, 188,189,190,191,194,219, 231,232,233,234,235,236, 246,251,259	18,34,57,159,187,192, 230,237,238,264	254,255,256	6,26,100,125,180,248, 253
PLANT RESISTANCE		3,14,45,47,63,64,79,80, 85,86,91,92,132,151,168, 169,176,177,208,215, 216,223,224,246,268	4,11,18,65,74,81,88,89, 90,95,96,102,112,126, 127,161,170,175,196	75,87,97,99,101,104, 105,110,111,123,124, 156,157,200,210,243	94,104,106,107,109,120, 153,155,158,195,222,242

PERIODICAL ABBREVIATIONS

- Acta Entomol. Bohemoslov. — Acta Entomologica Bohemoslova.
 Agr. Chem. — Agricultural Chemicals.
 Agr. Tec. Mex. — Agricultura Tecnica en Mexico.
 Agron. J. — Agronomy Journal.
 American Cyanamid Co. Leaf. — American Cyanamid Company Leaflet.
 Ann. Entomol. Soc. Amer. — Annals of the Entomological Society of America.
 Ann. Soc. Entomol. Fr. — Annales de la Société Entomologique de France.
 Annu. Rev. Entomol. — Annual Review of Entomology.
 Ariz. Agr. Exp. Sta. Bull. — Arizona Agricultural Experiment Station Bulletin.
 Ariz. Agr. Exp. Sta. Mimeo. Rep. — Arizona Agricultural Experiment Station Mimeographed Report.
 Ariz. Coop. Ext. Serv. Agr. Exp. Sta. Bull. — Arizona Cooperative Extension Service and Agricultural Experiment Station Bulletin.
 Ariz. Coop. Ext. Serv. Agr. Exp. Sta. Fold. — Arizona Cooperative Extension Service and Agricultural Experiment Station Folder.
 Arkansas Farm Res. — Arkansas Farm Research.
 Biul. Inst. Ochr. Rosl. — Biuletyn Instytutu Ochrony Roslin.
 Boll. Lab. Entomol. Agr. 'Filippo Silvestri' — Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri'.
 Bull. Brooklyn Entomol. Soc. — Bulletin of the Brooklyn Entomological Society.
 Bull. Entomol. Soc. Amer. — Bulletin of the Entomological Society of America.
 Calif. Agr. — California Agriculture.
 Calif. Agr. Exp. Sta. Ext. Serv. Leaf. — California Agricultural Experiment Station Extension Service Leaflet.
 Calif. Agr. Ext. Serv. Iden. Sheet — California Agricultural Extension Service Identification Sheet.
 Calif. Agr. Ext. Serv. Manuscript — California Agricultural Extension Service Manuscript.
 Calif. Dep. Agr. Quart. Bull. — California Department of Agriculture Quarterly Bulletin.
 Can. Entomol. — Canadian Entomologist.
 Commonw. Inst. Biol. Contr. Tech. Bull. — Technical Bulletin of the Commonwealth Institute of Biological Control.
 Crop Sci. — Crop Science.
 Crops Soils Mag. — Crops and Soils Magazine.
 Ekol. Pol. Ser. A. — Ekologia Polska-Seria A.
 Entomol. Rev. — Entomological Review.
 Environ. Entomol. — Environmental Entomology.
 Farm Manage. — Farm Management.
 Folia Entomol. Mex. — Folia Entomologica Mexicana.
 Indian Agr. — Indian Agriculturist.
 Indian J. Entomol. — Indian Journal of Entomology.
 Israel J. Entomol. — Israel Journal of Entomology.
 J. Econ. Entomol. — Journal of Economic Entomology.
 J. Environ. Qual. — Journal of Environmental Quality.
 J. Insect Physiol. — Journal of Insect Physiology.
 J. Kans. Entomol. Soc. — Journal of the Kansas Entomological Society.
 Kans. Agr. Exp. Sta. Mimeo. Ser. — Kansas Agricultural Experiment Station Mimeograph Series.
 Kans. Agr. Exp. Sta. Tech. Bull. — Kansas Agricultural Experiment Station Technical Bulletin.
 Mex. Secr. Agr. Ganad. Ofic. Estud. Espec. Foll. Tec. — Mexico Secretaría de Agricultura y Ganadería, Oficina de Estudios Especiales, Folleto Tecnico.
 Misc. Publ. Entomol. Soc. Amer. — Miscellaneous Publications of the Entomological Society of America.
 Miss. Agr. Forest. Exp. Sta. Annu. Rep. — Mississippi Agricultural and Forestry Experiment Station Annual Report.
 Mitt. Biol. Bundesanst. Land-Forstwirtsch. Berlin-Dahlem — Mitteilungen aus der biologischen Bundesanstalt fuer Land- und Forstwirtschaft Berlin-Dahlem.
 Mont. State Univ. Coop. Ext. Serv. Leaf. — Montana State University Cooperative Extension Service Leaflet.
 N. Mex. Agr. Exp. Sta. Bull. — New Mexico Agricultural Experiment Station Bulletin.
 Nebr. Agr. Exp. Sta. Bull. — Nebraska Agricultural Experiment Station Bulletin.
 Nebr. Agr. Exp. Sta. Res. Bull. — Nebraska Agricultural Experiment Station Research Bulletin.
 Nev. Agr. Exp. Sta. Circ. — Nevada Agricultural Experiment Station Circular.
 Okla. Agr. Exp. Sta. Bull. — Oklahoma Agricultural Experiment Station Bulletin.
 Okla. Agr. Exp. Sta. Processed Ser. — Oklahoma Agricultural Experiment Station Processed Series.
 Pr. Nauk. Inst. Ochr. Rosl. — Prace Naukowe Instytutu Ochrony Roslin.
 Probl. Agr. — Probleme Agricole.
 Proc. 10th Int. Congr. Entomol. (Montreal) — Proceedings of the 10th International Congress of Entomology (Montreal).
 Proc. 12th Int. Congr. Entomol. (London) — Proceedings of the 12th International Congress of Entomology (London).
 Proc. Forage Insect Res. Conf. — Proceedings of the Forage Insect Research Conference.
 Proc. Indiana Acad. Sci. — Proceedings of the Indiana Academy of Science.
 Proc. N. Cent. Br. Entomol. Soc. Amer. — Proceedings of the North Central Branch, Entomological Society of America.
 Progr. Agr. Ariz. — Progressive Agriculture in Arizona.
 Rep. Alfalfa Impr. Conf. — Report of the Alfalfa Improvement Conference.
 S. Dak. State Univ. Coop. Ext. Serv. Handb. — South Dakota State University Cooperative Extension Service Handbook.
 S. Pasture Forage Crop Improv. Conf. Rep. — Southern Pasture and Forage Crop Improvement Conference Report.
 Tex. Agr. Exp. Sta. Progr. Rep. — Texas Agricultural Experiment Station Progress Report.
 U.S. Dep. Agr. Agr. Handb. — United States Department of Agriculture, Agriculture Handbook.
 U.S. Dep. Agr. Res. Serv. Prod. Res. Rep. — United States Department of Agriculture, Agricultural Research Service, Production Research Report.
 U.S. Dep. Agr. ARS 22 — United States Department of Agriculture, Agricultural Research Service #22 Series.
 U.S. Dep. Agr. ARS 33 — United States Department of Agriculture, Agricultural Research Service #33 Series.
 U.S. Dep. Agr. Leaf. — United States Department of Agriculture Leaflet.
 Univ. Calif. Publ. Entomol. — University of California Publications in Entomology.
 Univ. Mo. Coop. Ext. Serv. Handb. — University of Missouri Cooperative Extension Service Handbook.
 Utah Agr. Exp. Sta. Mimeo. Ser. — Utah Agricultural Experiment Station Mimeograph Series.
 Utah Agr. Ext. Serv. Entomol. Mimeo Ser. — Utah Agricultural Extension Service, Entomology Mimeo Series.
 Utah Agr. Ext. Serv. Leaf. — Utah Agricultural Extension Service Leaflet.
 Utah Agr. Ext. Serv. Mimeo. Ser. — Utah Agricultural Extension Service Mimeograph Series.
 Utah Ext. Leaf. — Utah Extension Leaflet.
 Va. Agr. Exp. Sta. Tech. Bull. — Virginia Agricultural Experiment Station Technical Bulletin.
 Va. Polytech. Inst. Ext. Div. Contr. Ser. — Virginia Polytechnic Institute Extension Division Control Series.
 Zool. Listy — Zoologické Listy.
 Zool. Verh. Rijksmus. Natuur. Hist. Leiden — Zoologische Verhandelingen Rijksmuseum van Natuurlijke Historie Leiden.



